1987

Otitis media and its developmental effects on young children

Dawn M. Gibbs
The University of Montana

OTITIS MEDIA AND ITS DEVELOPMENTAL EFFECTS ON YOUNG CHILDREN

By

Dawn M. Gibbs

B.A., University of Washington, 1983

Presented in partial fulfillment of the requirements

for the degree of

Master of Communication Sciences and Disorders

University of Montana

1987

Approved by:

Sally Johnson
Chair, Board of Examiners

E C Murray
Dean, Graduate School

March 31, 1987
Date

ProQuest LLC.
789 East Eisenhower Parkway
P.O. Box 1346
Ann Arbor, MI 48106 - 1346

OTITIS MEDIA AND ITS DEVELOPMENTAL EFFECTS ON YOUNG CHILDREN

Submitted by Dawn M. Gibbs to fulfill
partial requirements for the completion
of the Master's of Communication
Sciences and Disorders
March 1, 1987

INTRODUCTION AND PURPOSE

There has been an abundance of research literature in recent years regarding otitis media (OM) and its possible effects on various aspects of development in young children. Articles on the subject have appeared in magazines and journals, from Newsweek (June 14, 1976) to professional medical publications. Despite growing interest and research efforts in the area of OM and its possible developmental sequelae, this disease continues to be a major health problem nationally in terms of the number of children affected and the economic costs of treatment (Rapin, 1979). To date, the etiology and pathogenesis of OM are not well understood. Techniques for diagnosis, treatment and management of the disease are controversial and continually change as new information becomes available about the disease itself and treatment effects. Finally, the long-term consequences have not been well-documented and are not well understood (Paradise, 1980). This paper will address the issues of definition, diagnosis, treatment effects and management of OM by a review of recent research literature.

Definition

What is otitis media (OM)? A frequently used definition is " an inflammation of the middle ear without reference to etiology or pathogenesis" (Bluestone, Klein, Paradise, Eichenwald, Bess, Downs, Green, Berko-Gleason, Ventry, Gray, McWilliams & Gates, 1983). The general category of OM is also known by many more specific descriptions including: nonsuppurative, secretory or serous OM (i.e. chronic OM) (Paradise & Rogers, 1980) as well as suppurative, purulent or bacterial OM (i.e. acute

OM) (Bluestone et al., 1983). Senturia, Bluestone, Lim, Klein & Paradise (1980) attempted to define OM in terms of the disease and manifestations of the disease process and this definition will be used in this paper. OM the disease is defined as "an inflammation of the middle ear (which may or may not be of infectious origin in contrast to "infection", which implies a microbiologic etiology)" (Senturia, et al., 1980). Effusion, defined as a "collection of liquid in the middle ear cavity" and otorrhea, a "discharge through a nonintact tympanic membrane" are considered to be evidence of the disease process (Senturia, et al., 1980). The temporal sequence of OM includes three stages: "acute", lasting from 0-3 weeks after onset; "chronic", defined as "persisting beyond the expected course" (over 12 weeks post-onset); and "subacute", or the interval between the acute and chronic stages (between weeks four and 12 post-onset) (Senturia, et al., 1980). Other literature describes these stages using similar labels. It is evident that a concensus of opinion is needed for both the definition and classification of OM.

Incidence and Prevalence

OM is one of the most common diseases of childhood and the most frequent reason for visits to the physician after well baby and child care visits. According to the National Center for Health Statistics (1973), OM is responsible for 33-50% of all patient visits to physicians in the first year of life (as cited in Garrard & Clark, 1985b). However, the epidemiology has not been well-documented. Episodes of OM may be undetected, either by the family physician, pediatrician or the parents. Clinical symptoms are often subtle or absent (i.e. malaise, ear tugging,

fever or mild hearing impairment) (Fiellau-Nikolajsen, 1980; Paradise & Smith, 1979).

Additionally, retrospective studies reporting the prevalence of OM have not used standardized criteria for diagnosis or for the type of OM reported (Biles, Buffler & O'Donnell, 1980). Despite problems with research design and questions over reported results, researchers agree that OM is most prevalent in the first two years of life, with the highest incidence of the initial episode of OM before 12 months (Howie, Ploussard & Sloyer, 1975; Paradise, 1980).

Howie, et al. (1975) described the "otitis-prone" condition in a retrospective study of 512 infants and children. They found that children who had experienced two or more episodes of OM before 12 months of age had at least twice the number of episodes as those children who experienced only one or no episodes before the same age. They further coined the phrase "otitis-prone", which describes a child who has had six or more episodes of OM before age six. In their study, 91% of the otitis-prone subjects had their first episode of OM before their first birthday.

Children at Risk

Results of this research (Howie, et al., 1975; Paradise, 1980) suggest children experiencing an episode or episodes of OM prior to age 12 months are at risk for future recurrent ear infections. Additionally, the literature reports general features that place a child at risk for single or recurrent episodes of OM. These include the following:

1. younger children who have greater susceptibility to infection in general, and specifically upper respiratory infections (Paradise, 1980; Shurin, Pelton, Donner & Klein, 1979);
2. children who frequently attend day care nurseries (Fiellau-Nikolajsen, 1980; Pukander, Luotonen, Timonen & Karma, 1985);
3. children having several siblings (Pukander et al., 1985) or living in a household with many members (Bluestone et al., 1983; Teele, Klein & Rosner, 1980);
4. males have greater incidence of OM than females (Bluestone et al., 1983; Paradise, 1980; Teele et al., 1980);
5. whites have greater incidence of OM than blacks with "other" (including Hispanic, Native American and Eskimo children) having the highest incidence (Bluestone et al., 1983; Shurin et al., 1979; Teele et al., 1980);
6. children with a family history of OM in siblings and parents (Downs, 1980; Paradise, 1980; Teele et al., 1980);
7. children who were bottle fed: Mother's milk has been found to help immunize children from OM. Researchers have also found that the position of feeding may have an effect on susceptibility to OM; when the child is lying down, the milk may more easily gravitate to the nasopharyngeal area and cause the Eustachian tube to become more susceptible to bacteria causing OM (Bluestone et al., 1983; Downs, 1980; Paradise, 1980);
8. children from a family with a low socio-economic status (SES) or who are culturally disadvantaged (Downs, 1980; Lewis, 1976; Paradise, 1980, 1981);

9. children with Downs syndrome and cleft palate (Black, 1983; Reichman & Healey, 1983);
10. children subject to inadequate parenting, to include poor nutrition (Bluestone et al., 1980; Downs, 1980; Lewis, 1976), neglect (Lewis, 1976), and poor medical care or follow-up (Paradise, 1981);
11. children with poor Eustachian tube function: research has found that function of the Eustachian tube is less efficient in infants than older children and adults, causing the ventilation of the middle ear system to be less efficient (Paradise, 1980); and
12. children who are chronically ill (i.e. quite frequently an episode of OM accompanies an upper respiratory infection (Black, 1983).

These reported conditions may not be all inclusive. Additionally, several of these conditions may exist concurrently making it difficult to pinpoint a primary cause of OM. However, when diagnosing a child with OM, knowledge of these conditions should be considered by professionals when recommending a course of treatment for both acute and chronic OM.

DIAGNOSIS OF OM AND OTITIS MEDIA WITH EFFUSION

Children with OM are typically identified by the family physician or a pediatrician. There are four methods of diagnosis: medical history, otoscopy, myringotomy and acoustic immittance testing. Each of these assessment procedures has both advantages and limitations as diagnostic tools.

Medical history can be helpful when determining if the child has a significant history of OM and when recommending a course of treatment. Reported clinical symptoms such as

otorrhea, obvious hearing loss or frequent upper respiratory infections (URI) may assist a physician in determining a possible course of treatment. However, history information is often unreliable. For obvious reasons, parents are not always able to remember frequency or duration of OM episodes. Additionally, clinical symptoms are often vague, subtle or absent (Paradise, 1980). For this reason, history information from the medical chart may not provide accurate or complete information.

Otoscopy is a subjective assessment tool in the diagnosis of OM. When performing an otoscopic examination, the diagnostician assesses the following: external canal condition, appearance, position and mobility of the tympanic membrane (TM) and other abnormalities of the TM (Bluestone & Cantekin, 1979). The external canal should be examined for excessive cerumen buildup and external otitis.

During otoscopy, the diagnostician may first assess the appearance of the TM. A normal TM should appear an almost translucent gray color with a well-defined light reflex (Jaffe, 1977). A slightly red appearing TM may be due to the child's crying; however, an intense or localized redness may be a sign that infection or effusion is present. Scarring may be present if the TM is abnormally white or may be a sign of pus in the middle ear cavity (Bluestone & Cantekin, 1979). A severely retracted TM may have an amber hue due to foreshortening of the malleus or from nonsuppurative effusion (Bluestone & Cantekin, 1979; Healey & Smith, 1981). A TM that lacks luster and appears dull may be due to previous inflammation. When viewing the TM for position, the diagnostician must assess whether the TM is in a neutral, retracted or bulging position

(Bluestone & Cantekin, 1979). The latter two conditions would be a sign of abnormal middle ear pressure.

Finally, the diagnostician should assess the mobility of the TM. The mobility of the TM is the most sensitive measure when diagnosing the presence or absence of effusion. A reduction in the mobility of the TM may be a sign of extensive scarring or more commonly, fluid in the middle ear cavity.

A frequently used tool in the assessment of the mobility of the TM is the pneumatic otoscope. A pneumatic otoscope is designed to allow a speculum to fit into the external canal causing an air-tight seal. Pressure is varied within the canal and mobility of the TM can be visualized (Jaffe, 1977; Paradise, 1980). Many researchers advocate the use of the pneumatic otoscope as "essential" in the diagnosis of otitis media (OM) or otitis media with effusion (OME) (Healey & Smith, 1981).

An objective method for validating a diagnosis of OM/OME is myringotomy or tympanocentesis (Bluestone & Cantekin, 1979). During a myringotomy, a surgical incision is made in the lower half of the TM and fluid is drained from the middle ear space. Although otoscopy is reliable, particulary when performed with a penumatic otoscope, it's reliability depends on the expertise of the diagnostician. Through a myringotomy, the diagnostician can reliably determine the presence or absence of effusion as well as the type of OME present. Additionally, as fluid is drained from the middle ear space, recovery is facilitated and the individual is provided relief from pain. However, this procedure is invasive and may require an anesthetic (Bluestone & Cantekin, 1979) which it less desirable for most diagnosticians.

Finally, acoustic immittance measurements (i.e. tympanometry and acoustic reflex testing) can be used in

the diagnosis of OM. Acoustic immittance (AI) testing is a non-invasive, simple and quick test procedure used to assess the condition of the middle ear and detect decreased middle ear mobility often associated with OME (Keith, 1973; Paradise, 1980). Acoustic immittance testing is objective and requires minimal cooperation on the part of the patient (Paradise, 1976; Paradise & Smith, 1979). It also requires neither the voluntary subject response necessary for audiometric testing or the judgment and expertise needed in otoscopic diagnosis (Paradise, 1980).

Tympanometry is now routinely used in the diagnosis of OM/OME. It is defined as a "measurement of minimal and maximal flow of acoustic energy through the middle ear that occurs as the air pressure gradient is varied across the typmanic membrane" (Jaffe, 1977). Tympanometry infers middle ear status, information regarding the tympanic membrane (TM) (whether or not it is intact), and results in a graph or tympanogram which can be used in the diagnosis of OM/OME.

The tympanogram is a graphic display of the change in a signal introduced through the external canal when the pressure in the canal is varied, and is classified by peak, amplitude and shape (Jaffe, 1977). Jerger (1970) describes three basic types of tympanograms associated with the presence or absence of OM/OME. A Type A tympanogram peaks at or about 0mm H2O and is considered normal while a Type B tympanogram is relatively flat suggesting decreased middle ear mobility which may be indicative of serous or adhesive OM. A Type C tympanogram peaks to the left of zero (negative pressure) which suggests negative pressure in the middle ear and may be indicative of early stages of middle ear effusion. When performing tympanometry, the range of air pressure change in the diagnosis of OM/OME should extend to -300mm H2O since most middle ear pathologies

occur in the negative pressure direction. Positive air pressure is typically extended to +100mm H2O. (Harford, Bess, Bluestone & Klein, 1978; Jaffe, 1977). A tympanogram with a low amplitude peak at normal air pressure may also be indicative of middle ear pathology (Jaffe, 1977; Tos & Poulsen, 1980). Paradise, Smith & Bluestone (1976, as cited in Bluestone & Cantekin, 1979) found that low-peaked negative pressure tympanograms were more likely to indicate chronic OM than high-peaked negative pressure tympanograms In the assessment of OM/OME using tympanometry, it is important to note that when OM is acute or in the early stages, effusion may not be well-established and tympanograms may be normal (Paradise, 1980). For this reason, it is important to re-screen children using tympanometry in follow-up examinations (Tos & Poulsen, 1980).

Though tympanometric testing has been performed on infants (Keith, 1973), it is thought to be an unreliable diagnostic measure for OME in children less than seven months old (Bluestone & Cantekin, 1979). This is primarily because of infant's collapsible and highly compliant external canal walls (Paradise, 1980).

Jerger, Jerger, Mauldin & Segal (1974) attempted to define a relationship between abnormal impedance results and audiometric findings. They analyzed the results of acoustic immittance (AI) testing on children from three to 71 months of age being seen for routine audiologic evaluations. Pure tone air- and bone-conduction and soundfield audiometric testing were performed along with AI testing. The results of this study indicated AI was the "single most powerful tool" in pediatric audiologic evaluation. In this study, AI results confirmed audiometric findings in 84% of the cases of children with normal ears, and supplemented soundfield and

bone-conduction results in 75% of cases when the tympanogram suggested middle ear pathology and when a conductive loss was found. AI results were also found to be beneficial when accurate audiometric data were not available or when only sound field results were obtained. This is important information for the assessment of children who are too young for pure tone audiometry on whom only behavioral data are available.

Acoustic reflex testing in the diagnosis of OM or otitis media with effusion (OME) is also being reported in recent literature (Bess, 1980; Bluestone & Cantekin, 1979; Jerger, et al., 1974). Bluestone & Cantekin (1979) state that the acoustic reflex can be used as a predictor for the absence of OME when contractions are present at or below 105 dB HL (contralateral stimulus) or 105 dBSPL (ipsilateral stimulus), or as a predictor of the presence of OME when contractions are absent. Jerger, et al. (1974) found that no reflex contractions were present in children with conductive or sensorineural hearing loss.

The following criteria have been proposed for the identification of OM/OME using a combination of otoscopy, tympanometry and acoustic reflex testing (Bluestone & Cantekin, 1979):

1. Absence of OM/OME
    a. otoscopy negative and tympanometry negative,
    b. otoscopy negative with positive tympanometry results and present middle ear reflex,
2. Presence of OM/OME - otoscopy positive and tympanometry positive, and
3. OM/OME possible
    a. otoscopy negative, tympanometry positive and reflex absent, or
    b. otoscopy positive and tympanometry negative, or

c. otoscopy indefinite and tympanometry positive or negative.

When diagnosing children with OM/OME, the physician or other professional should be cognizant of each diagnostic tool. Medical history along with pneumatic otoscopy and acoustic immittance testing provide a sophisticated assessment of children with suspected OM/OME. Acoustic immittance testing may be valuable in helping the diagnostician to confirm, refine or clarify a doubtful otoscopic diagnosis (Paradise, 1980) and for follow-up in patients with a previous history of middle ear disease. It is important to use AI testing in conjunction with otoscopy since it is an objective measure while otoscopy is frequently subjective (Bluestone & Cantekin, 1979). Myringotomy as a diagnostic tool may be used to determine the presence or absence of effusion but has serious limitations when compared to the other methods available.

EFFECTS OF OM/OME

Hearing Sensitivity

OM/OME has a known effect on the hearing sensitivity of young children; a conductive hearing loss resulting from middle ear effusion is the most common complication of the disease (Bluestone et al., 1983). This reported conductive hearing loss may result in an average hearing deficit of 27.6 dB HL through the speech frequency range (Bluestone, et al., 1983) or losses that range from 15-40 dB HL (Brooks, 1979). The hearing loss is generally mild, of short duration and fluctuating (Manders & Tyberghein, 1983; Paradise, 1980) and is dependent on the amount of effusion (Bluestone et al., 1983).

A child with OM without effusion may also be experiencing a hearing loss due to high negative pressure in the middle ear (Bluestone et al., 1983). A conductive hearing loss of 10dB HL or more was present in 50% of ears with negative pressure in a study reported by Bluestone, et al. (1983). Additionally, a hearing loss may be present when there is a perforation in the TM or there has been damage to the ossicular chain due to effusion (Jaffe, 1977).

In the past, some professionals and clinicians may not have seriously regarded middle ear problems and mild, fluctuating hearing loss as a concern (Berry, DelPolito, Katz, Madell, Olsen, Williams & Seidmann, 1979). This attitude has resulted in inefficient and poor management for the child experiencing hearing loss as a result of OM. Most professionals are now of the opinion that there should be greater concern over temporary and mild hearing losses (Rapin, 1979). It is this mild and fluctuating hearing loss that is a primary concern when addressing possible speech, language and academic delays.

Speech and Language

A review of recent literature reveals increasing information on hearing loss and speech and language delays associated with OM/OME. Because of the nature of the hearing loss associated with the disease (mild and fluctuating), children with chronic or recurrent OM/OME may be at risk for speech and language delays.

A consistent auditory signal is crucial during speech and language development. Naremore (1979) states that "to learn a language, one must segment the stream of sounds, assign meaning to the segments, and understand the rules governing the combination of segments into novel

utterances". Therefore, a fluctuating hearing loss is potentially detrimental to a child attempting to learn the rules for speech and language development. The child needs to be able to recognize individual speech sounds and this ability depends on hearing differences in frequency formants, qualities of sounds, durations of individual speech sounds, intensities and sequences of patterns (Skinner, 1978). Impaired hearing may jeopardize a child's ability to decode and segment the auditory signal (Rapin, 1979). They may fail to learn what aspects of the signal must be present for them to identify words in connected speech and establish rules for categorization (Jaffe, 1977). Additionally, their ability to attach meaning to words and abstract the rules of the language when the speech signal is distorted or absent may be impaired (Skinner, 1978). When a child is receiving an inconsistent auditory signal due to a fluctuating hearing loss, these acoustic cues may vary from day to day. A child with a stable, mild loss may even have an advantage over the child with a fluctuating loss since they are receiving a consistent auditory signal. The child with a stable loss may be better able to categorize speech sounds even if hearing acuity is inadequate for normal speech perception (Skinner, 1978).

A child with a fluctuating hearing loss may have difficulty hearing or may misunderstand linguistic endings (Bluestone et al., 1983), inflection, pause and stress indicators in connected speech (Menyuk, 1979; Dobie & Berlin, 1979; Garrard & Clark, 1985b), morphological markers (Dobie & Berlin, 1979; Garrard & Clark, 1985b), and short, unstressed words (Dobie & Berlin, 1979; Skinner, 1978). Skinner (1978) states that some aspects of connected speech may be inaudible with a loss as mild as 14 dB HL, while Dobie & Berlin (1979) state a 20 dB HL loss

may result in the inability to hear such linguistic information as plural endings and final position fricatives or voiceless consonants (Freeman & Parkins, 1979). If a child with a 15-40 dB HL hearing loss associated with OM/OME is "missing out" on this linguistic information, they may be at risk for speech and language delays.

Another important aspect of language development is the interaction between the parent and the child. When a child is chronically ill as they often are when experiencing recurrent OM/OME, their malaise, irritability and reduced attention may be detrimental to optimal language learning. Additionally, in this situation parents may assume a primary role of caregiver rather than interactional partner and quality and quantity of environmental language stimulation may decrease (Garrard & Clark, 1985a).

Recent literature suggests a correlation between OM/OME, conductive hearing loss and delayed language skills. Researchers have found that speech and language skills in children with chronic OM are delayed rather than deviant (Friel-Patti, Finitzo-Hieber, Conti & Clinton-Brown, 1982; Schlieper, Kisilevsky, Mattingly & Yorke, 1985). A longitudinal study of the consequences of bilateral OME was performed by Silva, Chalmers & Stewart (1986). The experimental group of five-year-olds with bilateral OME at the time of evaluation were tested for hearing sensitivity, intelligence, speech and language development, reading attainment and behavior. This study suggested that bilateral OME detected at five years may have been intermittently present in the experimental group before the age of three and an accompanying hearing loss may have been detrimental to normal language acquisition. They concluded that children with early language delays are at risk for later developmental problems, specifically low intelligence, reading problems and behavior problems. They further concluded that age five, and possibly even age

three, is too late to identify children with developmental delays resulting from bilateral OME. Children at age three with histories of OME had evidenced language skills below those children with normal ears. Because of this, early detection and treatment is crucial.

Schlieper et al. (1985) examined the speech and language of preschoolers with mild conductive hearing losses and histories of OM/OME. They found after the initial and one-year follow-up evaluations that children with recurrent middle ear problems lagged behind normal controls in their expressive language skills, particularly in expressive syntax.

A longitudinal study examining early language skills of "otitis-prone" infants revealed a 71.5% incidence of language delay with 42.9% delayed greater than six months (Friel-Patti et al., 1982). The majority of these subjects also showed evidence of fluctuating hearing based on auditory brainstem responses and acoustic immittance measures.

Results of these studies suggest a correlation between a history of OM/OME with an associated conductive hearing loss and speech and language delays. However, research in this area has been difficult to conduct because of numerous confounding factors. Speech and language development and hearing loss associated with OM/OME are influenced by:

1. severity of the hearing loss (may be mild to moderate and fluctuating),
2. length of time the loss persists,
3. consistency of the hearing loss,
4. timing, success and frequency of treatment as well as the type of treatment (i.e. ventilation tubes versus antibiotic therapy),
5. developmental integrity of the child, and
6. speech stimulation provided by the family and caregivers.

Academic Achievement

A relationship between otitis media, fluctuating hearing loss and academic performance has been suggested, but has not been firmly documented in recent literature. This area of research has received increased attention in recent years because of controversial issues over treatment of both OM and learning disabilities. Whether OM may predispose children to later learning problems has important implications for treatment and management of the disease. Results from a number of studies appear to link early and recurrent middle ear disease with later learning disabilities (Bennett, Ruuska & Sherman, 1980; Masters & Marsh, 1978; Zinkus, Gottlieb & Schapiro, 1978).

Bennett et al. (1980) investigated the association between chronic OM and school learning problems in children with identified learning disabilities (LD). They found that a significant number of LD children had a history of recurrent OM compared to controls. Additionally, only one of the experimental subjects had normal middle ear function at the time of the study. Masters & Marsh (1978) and Freeman & Parkins (1979) also found on-going middle ear problems in LD students. Brandes & Ehinger (1981) examined the effects of middle ear problems on academic achievement and auditory-perceptual skills. They looked at children with histories of OM (initial episode at or before age two) demonstrating on-going middle ear problems. Compared to control subjects, the OM children showed significantly lower scores overall, specifically on subtests of auditory perceptual abilities. Sak & Ruben (1981) compared children with documented histories of OME before age five with sibling controls. Subjects with histories of middle ear pathology had poorer verbal ability, auditory decoding

and spelling skills when compared to their normal hearing siblings.

In a longitudinal study of Alaskan Eskimo children, Kaplan, Fleshman, Bender, Baum & Clark (1973) found children with histories of OM before the age of two years demonstrated deficits in verbal ability and were behind in reading, math and language skills. Finally, Zinkus & Gottlieb (1980) and Zinkus, et al. (1978) compared two groups of children with auditory processing deficits. Group one had a history of severe chronic OM during their first three years of life with an average of 4.9 episodes during that time period. Group two had no significant history of ME problems. These two groups were compared in the areas of language development, auditory processing skills, intellectual factors and academic abilities. Results of this comparison revealed subjects in Group one were slower in developing word combinations (three word phrases), had depressed verbal intelligence scores, were poorer in reading and had auditory processing deficits (Zinkus & Gottlieb, 1980). They concluded from the results of this study that ME disease and it's accompanying hearing loss places a child experiencing learning problems at an even greater disadvantage.

Further systematic research needs to be completed before a relationship between early episodes of OM/OME and future learning problems can be assumed. However, preliminary evidence suggests OM/OME, hearing loss and delayed language skills may be associated with learning disabilities in children. Therefore, to avoid these possible language and educational problems, better management techniques for children with diagnosed OM/OME must be initiated.

TREATMENT AND MANAGEMENT OF OTITIS MEDIA

Medical

Once OM or OME have been diagnosed and confirmed, a course of treatment must be prescribed. The research literature describes a variety of medical management procedures to include one or a combination of the following treatment procedures: myringotomy, tonsillectomy and adenoidectomy (T&A), pressure equalization (PE) tube placement,
antimicrobial therapy, antihistamine or decongestant therapy and no treatment. As with any diagnostic method, there are both advantages and limitations to each of these treatment procedures.

As previously discussed, myringotomy is effective not only as a diagnostic measure, but also as a treatment procedure. However, myringotomy alone has not been widely used since the appearance of antimicrobial therapy (Northern, 1980). Myringotomy as a treatment procedure, however, has certain benefits:

1. it faciltiates rapid resolution of the ME infection, and
2. it may reduce the incidence or the duration of effusion following an infection (Northern, 1980).

Paradise (1977) advocates the use of myringotomy without tube placement after antimicrobial drugs have failed to eradicate the middle ear infection and the child has been free from effusion for over six months. However, if the child has had diagnosed effusion in the previous six months, myringotomy with tube placement should be performed (Paradise, 1977).

Paradise (1980) states myringotomy is still reasonable when ear pain is severe or when complications such as

mastoiditis or meningitis have developed. However, myringotomy as a treatment procedure has several limitations:

1. it is invasive, and
2. it frequently requires an anesthetic (Bluestone & Cantekin, 1979).

The use of myringotomy in the management of OM should be used cautiously. The physician will make the final decision concerning the course of treatment to be used.

Muenker (1980) addresses adenoidectomy as a management technique for OM and describes results of a study involving greater than 12,000 follow-up examinations. Prior to tympanostomy tube insertion, patients were subjected to adenoidectomy when "conservative measures" failed (these measures were not described). He states that a controversy exists over the use of adenoidectomy as a treatment procedure for OME because:

1. small or medium size adenoids may interfere with Eustachian tube function in 80% of children with OME though the adenoids may not be blocking the tube,
2. adenoidectomy is not always effective and further treatment is necessary, and
3. when adenoidectomy and myringotomy are performed with or without tube placement, it is impossible to independently evaluate each procedure.

In general, research data do not support the use of adenoidectomy for the treatment of OM (Jaffe, 1977).

PE tube placement is often a procedure used when OM or OME are diagnosed, with up to 2 million tubes inserted per year (Bluestone & Cantekin, 1979; Meyerhoff, 1981). The objective of myringotomy with tube placement is to:

1. ventilate the ME cavity,
2. remove the effusion, and

3. relieve the associated hearing loss (Meyerhoff, 1981; Paradise, 1977).

Many researchers have suggested criteria for tube placement. Healey & Smith (1981) use the following criteria: persistent effusion for more than three months with conductive hearing loss greater than 15dB HL; failure of four weeks of antimicrobial therapy; and severe OME showing retraction pockets or impending cholesteatoma. Fior & Veljak (1984) found that PE tube placement when performed correctly helped prevent recurrence of OM/OME and should be considered a long-term prophylaxis of the otitis-prone child. Healey & Smith (1981) found that approximately 80% of their intubated patients responded to one insertion and no further therapy was required.

However, the literature reports complications and sequelae of tube placement that cannot be ignored. Possible complications include the following:

1. risk of anesthesia, including death;
2. infection (Muenker, 1980);
3. excessive ear discharge resulting in removal of the tube or mastoid surgery (Fernandez-Blasini, 1985; Muenker, 1980);
4. granulation tissue around the tube (Muenker, 1980);
5. persistent or permanent perforations (Bluestone & Cantekin, 1979; Fernandez-Blasini, 1985; Meunker, 1980);
6. cholesteatoma (Fernandez-Blasini, 1985; Muenker, 1980; Naunton, 1981);
7. defects of the ossicular chain (Bluestone & Cantekin, 1979; Muenker, 1980; Naunton, 1981);
8. visible scars (Muenker, 1980; Naunton, 1979); and
9. hearing loss (Bluestone & Cantekin, 1979; Naunton, 1981).

Though these reported complications are serious and should not be disregarded, research has not shown whether these complications are a result of surgery or tube placement versus a sequelae of the OM (Fior & Veljak, 1984). Meyerhoff (1981) reports that in animal experiments tube placement caused little or no permanent damage to the TM when no ME disease was present. These and other researchers advocate that the benefits of tube placement far outweigh the risk of possible complications or sequelae (Armstrong & Armstrong, 1980; Paradise & Rogers, 1986).

Most literature does not advocate immediate tube placement after a diagnosis of OM or OME. Antimicrobial therapy is recommended for a period of three to six months before surgical intervention is considered. Antimicrobial drugs are routinely used in the treatment of acute OM because research has shown that:

1. the incidence of suppurative OM complications has significantly decreased since antimicrobial therapy came into use;
2. bacteria frequently found in effusion has responded well to drug therapy; and
3. the small number of prospective studies that have been systematically performed have shown excellent results in children treated with antimicrobial drugs (Paradise, 1980).

Antimicrobial drugs are also used as a prophylaxis in an attempt to prevent new episodes of OM (Bluestone, Carder, Coffey, Kenna, Pelton, McCracken & Nelson, 1985). For a course of antimicrobial therapy to be effective, high compliance on the part of the parents is necessary (Jaffe, 1977). Parents should be informed of the importance of

both administering the drug on a daily basis and bringing their child back to the physician for follow-up examination.

The use of antihistamines or decongestants for nonsurgical treatment of OM has been discussed in the research literature. Bierman & Furukawa (1978) state that these medications often benefit problems related to OM (i.e. sinusitis due to allergy) and "only by inference" have a beneficial influence on OM. Controlled and systematic studies have not been performed proving the benefits of such treatment (Bierman & Furukawa, 1978). Paradise (1980) also states it is unlikely that these over-the-counter medications are efficacious but this will not be known until further prospective research has been completed.

Finally, many physicians believe that once OM has been diagnosed, a conservative approach is necessary. Since the natural course of OM is not known and OM may be self-limiting, (Stickler, 1984; Tos & Poulsen, 1980) the first treatment may be no treatment. Physicians should insure careful and systematic follow-up when aggressive treatment is not given due to the possible recurrence of the disease and/or possible developmental effects of OM on the young child.

Medical management of OM was the subject of a questionnaire submitted to 500 otolaryngologists (Armstrong & Armstrong, 1980). Responses from 325 participants were broken down using a computer-assisted analysis. In general, nonsurgical medical treatment was reported to be 50% effective, with most otolaryngologists abandoning decongestants, antihistamines or antibiotics after one to two months in favor of PE tube placement. The majority of the respondents reported use of PE tubes when appropriate (after failure of nonsurgical management or if the patient had fluid for an extended period of time) with good to

excellent results in 90% of their patients. Of the participants in the survey, 83% felt that the frequency of chronic ear disease was reduced after tube placement. Tubes were also reported as a prophylactic treatment for OM in 64% of the respondents versus 35% advocating prophylactic antibiotics. In general, PE tubes were embraced as the "greatest single contribution to otology in the past 50 years" (Armstrong & Armstrong, 1980).

Physicians must make their most informed decision on the course of treatment for the child with OM. Their knowledge of the benefits and limitations of each procedure available should be applied to each individual child. The physician should be aware of literature that suggests a correlation between OM and possible developmental delays to encourage aggressive treatment of chronic OM. This additional knowledge may assist they physician in choosing a course of treatment that considers the whole child.

Audiologic

A number of researchers and committees have suggested wide-scale acoustic immittance screening of preschoolers to identify OM and middle ear effusion in a timely manner (Bess, 1980; Bess, Bluestone, Harford, Harrington & Klein, 1978; Northern, 1980; Paradise & Smith, 1979; Tos & Poulsen, 1980; Zinkus, et al., 1978). Acoustic immittance (AI) testing is easy, reliable, and accepted criteria and facilities are available in most communities. Harford, Bess, Bluestone & Klein (1978) and an ASHA Committee on Audiometric Evaluation (Berry, et al., 1979) outline procedures for screening to include both tympanometry and acoustic reflex testing. They also propose pass/fail criteria which includes guidelines for retest and

referral. However, neither of these two committees advocate immediate initiation of wide-scale screening until further research has been completed. Researchers also argue that because OM is often self-limiting, a wide-scale screening is not practical either in terms of money or time. Additionally, the natural course of OM is not known; some cases resolve spontaneously and others continue for months.

Another argument against mass screening is that research has shown that a single tympanometric screening is not reliable (Fiellau-Nikolajsen, 1984; Tos, Holm-Jensen, Sorensen & Mogensen, 1982; Tos & Poulsen, 1980). Tos & Poulsen (1980) demonstrated in a study where five repetitive screenings were performed in one year that 50% of the children tested changed tympanogram types between trials. Spontaneous improvement of middle ear status was high, though some ears deteriorated. Because of the possibility of deterioration, they suggested re-screening children with normal as well as abnormal tympanograms.

Generally, a wide-scale acoustic immittance screening program using only one technique is not recommended. Yet children with subtle otologic problems will continue to be overlooked by parents and traditional hearing screening programs utilizing only pure-tone audiometry. Northern (1980) suggests an acoustic immittance screening program be used in conjunction with routine hearing screening. These two techniques together would increase the accuracy of the screening program while reducing the number of children requiring a retest and increasing the probability of identifying children with middle ear problems. While research to clarify the cause and effect of OM continues, this type of screening program may effectively increase the number of children identified and treated.

Speech and Language

As with auditory management of OM children, early detection and treatment of speech and language problems is also important. Speech and language delays need to be treated before a child becomes frustrated by unsuccessful attempts to communicate or is significantly delayed.

Parents and professionals should be educated about possible speech and language problems resulting from chronic OM for prevention and early detection. This can be accomplished in a variety of ways. Professionals can participate in in-service training given by certified speech-language pathologists. Physicians can be trained to screen for speech and language delays at well baby visits, and/or parents can be required to fill out a speech-language screening form for their child at these visits so proper referrals can be made. Information about language development and hearing status should also be included. Parents can be educated about OM and it's impact on their child through written material, public lectures or community workshops. Garrard & Clark (1985a) give an excellent outline of topics and content to be covered. Parents should also be alerted to the attentiveness and responsiveness of their child, as well as other clinical symptoms including ear tugging, behavior problems at home or at school, irritability or restlessness. They need to be informed about their role as interactional partners for language learning and be advised on how OM and it's complications may have an effect on their interaction with their child.

When speech or language delays are diagnosed, the speech-language pathologist can educate the parents as previously mentioned. Additionally, language stimulation techniques can be taught to parents for better facilitation

of language learning in the home.

Research data do not clearly confirm a relationship between early, chronic OM and learning disabilities. However, the literature does indicate that learning-disabled children tend to demonstrate a history of on-going middle ear pathology (Bennett et al., 1980; Freeman & Parkins, 1979; Masters & Marsh, 1978). A program for frequent follow-up and audiological evaluations could be initated for LD children to provide for early identification of middle ear problems. In this way, these children can receive proper management to afford them the best advantage in their learning situation. Additionally, those children with a history of early and recurrent OM should be followed closely by teachers when they enter school for possible academic deficits (i.e. reading, spelling, auditory processing) (Kaplan et al., 1973).

Early identification and treatment of children who may be at risk for future developmental problems due to OM could ultimately be cost-effective. The cost of mass preschool and elementary school speech and language, intelligence and auditory processing or perceptual evaluation of children with a history of ME disease would be prohibitive (Zinkus et al., 1978). Therefore, early detection programs and proper medical treatment of OM/OME based on prospective, systematic research is the ultimate goal for concerned professionals.

Continued Research

Information about OM and it's possible devastating effects on children first appeared in the pediatric literature in 1965. In the past several years, research articles have appeared in pediatric, audiologic and

otolaryngologic journals with a "small explosion" of information (Bergstrom, 1980). Many researchers have indicated concern about possible developmental delays resulting from OM/OME. Research data have been reported that link OM to hearing loss, speech and language delays and poor academic performance. However, there has also been an abundance of literature published criticizing this research. This criticism generally discounts data supporting a theory that OM may be a cause of developmental delays in children.

The major areas of criticism include inadequate sample size and selection, examiner bias, flaws in research design and compounding factors not addressed. Ventry (1980) evaluated a number of research studies and stated "few valid data support a causal link between conductive hearing impairment (including mild and fluctuating losses) and language, learning or non-peripheral auditory deficits".

Of particular interest is a longitudinal study examining the effects of OM on a group of Alaskan Eskimo children. Results of this study demonstrate that a significant correlation exists between recurrent OM, conductive hearing loss and language and academic deficits. This correlation is referenced in numerous published studies and results are reported as valid. However, researchers did not take into account inadequate audiologic testing and data, large differences in sample size, inadequate description of statistical tests used, and reporting of only that data supporting their hypothesis (Ventry, 1980). Another "landmark" study frequently referenced in the literature (Zinkus, et al., 1978) concerns the correlation between chronic OM in the first three years of life and substantial delays or deficits in speech and language, auditory processing, auditory-visual

integration, reading and spelling. One important flaw in this study is the methodology used to assess language delay. The authors report "profound delays in language development" based on parental report of the age at which their child had an expressive vocabulary of four to ten words and when they began using three-word (or longer) phrases. These authors also failed to report statistical tests utilized to examine their data.

General criticisms of research in this area include the following:

1. studies are retrospective in design and depend on medical records and/or parental recall making the diagnosis of OM of uncertain validity (Bess, 1980; Garrard & Clark, 1985a; Manders & Tyberghein, 1984; Paradise & Rogers, 1980; Reichman & Healey, 1983),
2. studies include a small number of subjects, yet there has been a wide generalization of results (Bess, 1980; Garrard & Clark, 1985a; Manders & Tyberghein, 1984; Paradise, 1980, 1981; Paradise & Rogers, 1980),
3. studies have included questionable subject selection procedures (Manders & Tyberghein, 1984; Paradise & Rogers, 1980; Reichman & Healey, 1983),
4. a lack of data exists on the hearing levels of subjects early in life (Bess, 1980; Garrard & Clark, 1985a; Rapin, 1979; Reichman & Healey, 1983),
5. the hearing status of subjects at the time of the evaluation has not been reported (Bess, 1980; Garrard & Clark, 1985a; Paradise, 1981; Reichman & Healey, 1983),
6. subjects were not adequately matched regarding potentially confounding variables such as SES, quality of parenting, environmental language stimulation, intelligence, cultural factors, and general health status (Brandes & Ehinger, 1981; Garrard & Clark,

1985a; Manders & Tyberghein, 1984; Paradise & Rogers, 1980; Paradise, 1981; Schlieper et al., 1980),

7. tests used were of questionable validity (Garrard & Clark, 1985a),

8. reliability of examiners has not been documented (Reichman & Healey, 1983; Ventry, 1980), and

9. examiners may have been biased (Garrard & Clark, 1985a; Paradise, 1981).

Another criticism of current published research is the inability to compare and generalize results because of the wide variety of tests used in subject evaluation (Bess, 1980; Brandes & Ehinger, 1981; Reichman & Healey, 1983). Finally, some researchers have concluded that though a correlation may exist between OM and developmental delays, there may also be a common underlying factor that predisposes a child to both (Manders & Tyberghein, 1980; Paradise & Rogers, 1980), such as:

1. pregnancy or perinatal risk factors,

2. subtle central nervous system or neuromuscular dysfunction,

3. low socio-economic status,

4. large number of siblings,

5. inferior or inadequate parenting,

6. recurrent or chronic upper respiratory infections, or

7. respiratory or other allergies (Paradise, 1980).

There are also significant ethical limitations when conducting research that involves a disease such as otitis media that is both self-limiting and chronic, and an area such as hearing impairment. Ethical considerations will not allow professionals to allow a child to go untreated when OM or a hearing loss has been diagnosed. This is especially true in light of the possible developmental

delays that may result and general health considerations. For example, it is not possible to justify withholding medical or surgical treatment for OM to determine if developmental delays will result. Another limitation is the difficulty encountered when testing young children. Audiometric, otoscopic and/or acoustic immittance data are not always available because: tympanometry is not recommended for infants under seven months, though these same infants may experience OM; the TM is often difficult to visualize and findings may be difficult to interpret; it is difficult to obtain reliable results from hearing evaluations (Rapin, 1979; Paradise, 1976). Studies in this area may be difficult, involved, expensive and time-consuming. However, research is necessary to clarify the issues.

One benefit of the research that has been conducted in the area of OM, whether good or bad, has been the response and concern of medical professionals, audiologists, and speech-language pathologists to the possible impact of the disease on children and their family (Garrard & Clark, 1985b). Because of this concern and the dissatisfaction with recently published research, various professionals and researchers have voiced a need for further research. Some of the unanswered questions that need to be addressed are:

1. What is the natural course of the disease (Paradise, 1976)?
2. What types of OM need to be studied? What is the definition of OM and how will it be classified (Bluestone & Cantekin, 1979)?
3. How often should patients be observed? What should the number of observations be based on (season, number of episodes, condition of ears at the last visit, sex,

history, etc.) (Bluestone & Cantekin, 1979)?

4. How should subjects be chosen? Referrals by extremes (children with most and least episodes of OM) or randomly selected from the general population (Zinkus & Gottlieb, 1980)?

5. What test instruments have the most sensitivity (ability to identify diseased ears) and specificity (ability to identify non-diseased ears) (Bess, 1980)?

6. What management procedures are most effective (Bess, 1980)?

7. What is the most effective and efficient method of identifying children with OM/OME?

8. How detrimental is a mild, fluctuating hearing loss on development (Paradise, 1977)?

9. How can professionals predict reliably what course the disease will follow (spontaneous recovery or chronic disease) (Paradise, 1977)?

10. Are delays that are identified early on permanent or will the child "catch up" (Silva, Chalmers & Stewart, 1986)?

11. What factors in conjunction with OM contribute to long-term deleterious effects on children (Menyuk, 1980)?

Large scale prospective studies are necessary to answer these questions. Menyuk (1980) offers several suggestions for research. First, a plan to carry out a number of small studies, assessing each variable or combination of variables while holding the remaining variables constant may be implemented. Or a prospective study may compare subjects from age six months to nine years that are considered most "at risk" and least "at risk" on a variety of measures. Friel-Patti, et al. (1982) call for abandoning retrospective between-subject research designs

and increased use of correlational, and experimental and descriptive within-subject designs.

One method that may be used to address these unanswered questions and execute prospective, systematic research is the implementation of an "otitis media clinic". A multi-disciplinary team to include an otologist, a pediatrician, a speech-language pathologist, an audiologist and support personnel such as technicians and secretarial staff, could be housed in one location. Together they could provide consistent and systematic patient care for the prevention of future speech, language and learning problems that may be associated with OM. In addition to the "OM clinic team" a number of professionals in the community may be the recipients of referrals, such as physical therapists, occupational therapists, or social workers, for additional management as necessary. It will be important to address the logistics of this clinic for optimal patient care and execution of research. At this time, a "model clinic" is beginning at Fitzsimons Army Medical Center in Aurora, Colorado. The information presented in this paper is being taken into consideration as a protocol for patient management and systematic research is being developed.

BIBLIOGRAPHY

Armstrong, B. W. & Armstrong, R. B. (1980). Chronic nonsuppurative otitis media: Comparison of tympanostomy tubes and medication versus ventilation. Annals of Otology, Rhinology & Laryngology, 89(3), 533-536.

Bennett, F. C., Ruuska, S. H. & Sherman, R. (1980). Middle ear function in learning-disabled children. Pediatrics, 66(2), 254-260.

Bergstrom, L. (1980). Continuing management of conductive hearing loss during language development. International Journal of Pediatric Otorhinolaryngology, 2, 3-9.

Berry, Q., Del Polito, G., Katz, D., Madell, J., Olsen, W., Williams, P. & Seidmann, M. (1979). Guidelines for acoustic immittance screening of middle-ear function. ASHA, 21(4), 283-288.

Bess, F. H. (1980). Impedance screening for children. Annals of Otology, Rhinology & Laryngology, 89(3), 228-232.

Bess, F. H., Bluestone, C. D, Harford, E. R., Harrington, D. A., & Klein, J. O. (1978). Use of acoustic impedance measurement in screening for middle ear disease in children. Annals of Otology, Rhinology & Laryngology, 87, 288-292.

Bierman, C. W. & Furukawa, C. T. (1978). Medical management of serous otitis in children. Pediatrics, 61, 768-774.

Biles, R. W., Buffler, P. A. & O'Donnell, A. A. (1980). Epidemiology of otitis media: A community study. American Journal of Public Health, 70, 593-598.

Black, N. (1983). Causes of glue ear. An historical review of theories and evidence. Journal of Laryngology & Otology, 99, 953-966.

Bluestone, C. D. & Cantekin, E. I. (1979). Design factors in the characterization and identification of otitis media and certain related conditions. Annals of Otology, Rhinology & Laryngology, 88, 13-28.

Bluestone, C. D., Carder, H. M., Coffey, J. D., Kenna, M. A., Pelton, S. I., McCracken, G. H. & Nelson, J. D. (1985). Consensus: Management of the child with a chronic draining ear. Pediatric Infectious Diseases, 4(6), 607-612.

Bluestone, C. D., Klein, J. O., Paradise, J. L., Eichenwald, H., Bess, F. H., Downs, M. P., Green, M., Berko-Gleason, J., Ventry, I. M., Gray, S. W., McWilliams, B. J. & Gates, G. A. (1983). Workshop on effects of otitis media on the child. Pediatrics, 71. 639-651.

Brandes, P. J. & Ehinger, D. M. (1981). The effects of early middle ear pathology on auditory perception and academic achievement. Journal of Speech and Hearing Disorders, 46(3), 301-307.

Brooks, D. N. (1979). Otitis media and child development. Design factors in the identification and assessment of hearing loss. Annals of Otology, Rhinology & Laryngology, 88, 29-47.

Dobie, R. A. & Berlin, C. I. (1979). Influence of otitis media on hearing and development. Annals of Otology, Rhinology & Laryngology, 88, 48-53.

Downs, M. P. (1980). Identification of children at risk for middle ear effusion problems. Annals of Otology, Rhinology & Laryngology, 89(2), 168-171.

Fernandez-Blasini, M. (1985). Use and abuse of ventilation tubes. American Journal of Otology, 6, 142-144.

Fiellau-Nikolajsen, M. (1980). Tympanometry in three-year-old children. Prevalence and spontaneous course of MEE. Annals of Otology, Rhinology & Laryngology, 89,(3), 223-237.

Fior, R. & Veljak, C. (1984). Late results and complications of tympanostomy tube insertion for prophylaxis of recurrent purulent otitis media in pediatric age. International Journal of Pediatric Otorhinolaryngology, 8. 139-146.

Friel-Patti, S., Finitzo-Hieber, T., Conti, G. & Clinton-Brown, K. (1982). Language delay in infants associated with middle ear disease and mild, fluctuating hearing impairment. Pediatric Infectious Diseases, 1(2), 104-109.

Freeman, B. A. & Parkins, C. (1979). The prevalence of middle ear disease among learning impaired children. Clinical Pediatrics, 18(4), 205-212.

Garrard, K. R. & Clark, B. S. (1985a). A practical guide to training parents of children with otitis media. NSSLHA Journal, 50-70.

Garrard, K. R. & Clark, B. S. (1985b). Otitis media: The role of the speech-language pathologist. ASHA, 27(7), 35-39.

Harford, E., Bess, F., Bluestone, C. & Klein, J. Impedance screening for middle ear diseases in children. New York: Grune & Stratton, 1978.

Healy, G. B. & Smith, H. G. (1981). Current concepts in the management of otitis media with effusion. American Journal of Otolaryngology, 2(2), 138-144.

Howie, V. M., Ploussard, J. H. & Sloyer, J. (1975). The "otitis-prone" condition. American Journal of Diseases in Children, 129, 676-678.

Jaffe, B. F. (1977). Hearing Loss in Children. Baltimore: University Park Press.

Jerger, J. (1970). Clinical experience with impedance audiometry. Archives of Otolaryngology, 92, 311-324.
Jerger, S., Jerger, J., Alford, R & Abrams, S. (1983). Development of speech intelligibility in children with recurrent otitis media. Ear and Hearing, 4(3), 138-145.

Jerger, S., Jerger, J., Mauldin, L. & Segal, P. (1974). Studies in impedance audiometry. Archives of Otolaryngology, 99, 1-9.

Kaplan, G., Fleshman, J., Bender, T., Baum, C. & Clark, P. (1973). Long-term effects of otitis media: A ten-year cohort study of Alaskan Eskimo children. Pediatrics, 52(4), 577-585.

Keith, R. W. (1973). Impedance audiometry with neonates. Archives of Otolaryngology, 97, 465-467.

Lewis, N. (1976). Otitis media and linguistic incompetence. Archives of Otolaryngology, 102, 387-390.

Manders, E. & Tyberghein, J. (1984). The possible effects of conductive hearing loss on language development. Acta Oto-Rhino-Laryngologica Belgica, 38, 255-260.

Masters, L. & Marsh, G. E. (1978). Middle ear pathology as a factor in learning disabilities. Journal of Learning Disabilities, 11, 54-57.

Menyuk, P. (1979). Design factors in the assessment of language development in children with otitis media. Annals of Otology, Rhinology & Laryngology, 88(5), 78-87.

Menyuk, P. (1980). Effect of persistent otitis media on language development. Annals of Otology, Rhinology & Laryngology, 89(3), 257-263.

Meyerhoff, W. L. (1981). Use of tympanostomy tubes in otitis media. Annals of Otology, Rhinology & Laryngology, 90, 537-542.

Muenker, G. (1980). Results after treatment of otitis media with effusion. Annals of Otology, Rhinology & Laryngology, 89(3), 308-311.

Naremore, R. C. (1979). Influences of hearing impairment on early language development. Annals of Otology, Rhinology & Laryngology, 88(5), 54-63.

Naunton, R. F. (1981). Panel on experiences with middle ear ventilating tubes. Tympanostomy tubes: The conservative approach. Annals of Otology, Rhinology & Laryngology, 87, 529-532.

Northern, J. L. (1980). Impedance screening. An integral part of hearing screening. Annals of Otology, Rhinology & Laryngology, 89(3), 233-235

Paradise, J. L. (1980) Otitis media in infants and children. Pediatrics, 65(5), 917-943.

Paradise, J. L. (1977). On tympanostomy tubes: Rationale, results, reservations, and recommendations. Pediatrics, 60(1), 86-90.

Paradise, J. L. (1980). Otitis media in infants and children. Pediatrics, 65(5), 917-943.

Paradise, J. L. (1981). Otitis media during early life: How hazardous to development? A critical review of the evidence. Pediatrics, 68(6), 869-873.

Paradise, J. L. & Rogers, K. D. (1980). Ubiquitous otitis media: A child health problem of uncertain dimension. American Journal of Public Health, 80(6), 577-578.

Paradise, J. L. & Rogers, K. D. (1986). On otitis media, child development, and tympanostomy tubes: New answers or old questions? Pediatrics, 77(1), 88-92.

Pukander, J., Luotonen, J., Timonen, M. & Karma, P. (1985). Risk factors affecting the occurrence of acute otitis media among 2-3-year-old urban children. Acta Otolaryngology (Stockholm), 100, 260-265.

Rapin, I. (1979). Conductive hearing loss effect on children's language and scholastic skills. Annals of Otology, Rhinology & Laryngology, 88, 12-16.

Schlieper, A., Kisilevsky, H., Mattingly, S. & Yorke, L. (1985). Mild conductive hearing loss and language development: A one-year follow-up study. Developmental and Behavioral Pediatrics, 6(2), 65-68.

Shurin, P. A., Pelton, S. I., Donner, A. & Klein, J. O. (1979). Persistence of middle-ear effusion after acute otitis media in children. New England Journal of Medicine, 300(20), 1121-1123.

Silva, P. A., Chalmers, D. & Stewart, I. (1986). Some audiological, psychological, educational and behavioral characteristics of children with bilateral otitis media with effusion: A longitudinal study. Journal of Learning Disabilities, 19(3), 165-169.

Skinner, M. W. (1978). The hearing of speech during language acquisition. Otolaryngologic Clinics of North America, 11(3), 631-650.

Stickler, G. B. (1984). The attack on the tympanic membrane. Pediatrics, 73, 291-292.

Teele, D. W., Klein, J. O. & Rosner, B. A. (1980). Epidemiology of otitis media in children. Annals of Otology, Rhinology & Laryngology, 89(3), 5-6.

Tos, M. & Poulsen, G. (1980). Screening tympanometry in infants and two-year-old children. Annals of Otology, Rhinology & Laryngology, 89(3), 217-222.

Tos, M., Holm-Jensen, S., Sorensen, C. H. & Mogensen, C. (1982). Spontaneous course and frequency of secretory otitis in 4-year-old children. Archives of Otolaryngology, 108, 4-10.

Ventry, I. M. (1980). Effects of conductive hearing loss: Fact or fiction. Journal of Speech & Hearing Disorders, 65, 143-156.

Zinkus, P. W. & Gottlieb, M. I. (1980). Patterns of perceptual and academic deficits related to early chornic otitis media. Pediatrics, 66(2), 246-253.

Zinkus, P. W., Gottlieb, M. I. & Schapiro, M. (1978). Developmental and psychoeducational sequelae of chronic otitis media. American Journal of Diseases in Children, 132, 1100-1104.